

# The potential of InSAR for assessing meltwater lake dynamics on Antarctic ice shelves

## **Reviewer comments**

**General comments:** This paper evaluated the beneficial of combining SAR amplitude, InSAR coherence and phase information for meltwater lake dynamics. The topic fits well with The Cryosphere journal and it provides useful information for investigation for lake dynamics in Antarctic environment. The selected cases over Amery and Roi Bauouin ice shelves (RBIS) shows that SAR amplitude, InSAR coherence and phase are complimentary for lake dynamics monitoring. However, I think the presented examples may oversimplify the interpretation of SAR amplitude, coherence and phase for monitoring meltwater lake dynamics, as we know other factors, other than seasonal melting-refreeze process, such as weather event (snow, rainfall, et,al) and sensor acquisition geometry (descending/ascending) could also affect amplitude/coherence/phase variation. There are also some other issues with this paper, such as convincing evidence about the lake status in the analysis, and incomplete/confusing data information that were used in the study. Please see my comments for details:

## **Specific comments**

1) Instead of just few selected data, please provide a complete time series amplitude, coherence and phase analysis for the cases in Fig 4 & Fig 5. I think this would still show the benefits of different information (amplitude, coherence and phase), but it would provide a more objective sense/perspective for reader to understand potential drawbacks of each different information. Incomplete data also make some of the statements confusing in the paper. For example, Line 155-157, it talked about amplitude/coherence for summer melting, but there are no SAR data shown in the Fig 4.

2) Please provide evidence when refer to melting/refreeze/frozen status of the lake to make your statement convincing. For example, the authors explained the decorrelation in Jan 2017 data is due to melting (Line 195-196) in Fig 7. However, in this same figure, we see the Jan 2018 shows very good coherence and phase pattern. I would assume the area would be in similar freeze/melt status at approximate same time of different years. I am not sure whether the low coherence in Jan 2017 is due to melting or maybe other weather events. I think it would be helpful to collect some other information, such as temperature information from other sources, to support your statement. For all other data analysis, if it's possible to collect some external information such as temperature or optical imagery, I would suggest doing so that it's more convincing when you state its under melt or refreeze or frozen status.

3) Incomplete data information. For the time series of mean and standard deviation over selected polygons mentioned in Fig 2, How many SAR data are used for this calculation and what are their acquisition times? are the mean and std for all the polygons shown in Fig 1? It might be helpful to provide complete data list in text or supplement. Are the coherence data for Amery all 12-days product? It would be not meaning to mix 6-days or 12 days data together to analyze lake-related information, as temporal difference would change that a lot.

Please show the outline of the sentinel-1 data in the last panel of Fig 1. What is the data coverage used in this study? Table 1 shows RBIS SLC data is from 2017/7/25—2018/4/15, however, in fig 2, the data coverage for RBIS is from 2017/1-2018/1, it is so confusing. Please provide accurate

info for data you used. Also, the GRD and SLC time coverage are different as shown in fig 2, not sure how does this happen. I would assume you need to analyze amplitude/coherence/phase comparison for all data.

4) Are there any different characteristics in amplitude/coherence/phase between supraglacial and englacial lake?

**Technical correction:**

Line 113, 'the results', please be more specific.

Fig 2. Please provide complete legends for subplots 2-4. Fig caption are not complete. It only takes about the time series, but not the specific amery a, b, d and RBIS examples.